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EFFECT OF NITROGEN OXIDES ON SEVERAL PLANTS

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EFFECT OF NITROGEN OXIDES ON SEVERAL PLANTS
[Chisso sankabutsu no nisan shokubutsu ni oyobosu eikyō]

by

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Those of the nitrogen oxides which present problems in atmospheric pollution are nitrogen monoxide and nitrogen dioxide. Plant exposure experiments were performed using these two gases in order to study their effects.

The plants were put in an exposure room consisting of a tunnel type PVC house with ventilation fans at the inlet and outlet. The prescribed amount of gas was admitted continuously at the inlet ventilation fan in order to expose the plants to the gases. The gas concentrations inside the exposure room were measured by the detection

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tube and Saltzman method (for concentrations of 1 ppm or more) or by means of automatic measuring instruments (manufactured by Denki Kagaku Keiki).

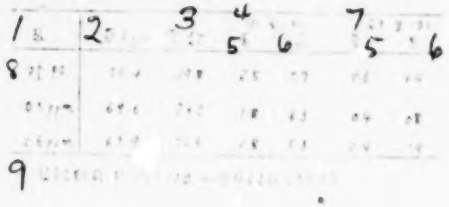
The exposure experiments with nitrogen monoxide were carried out for seven hours (on June 18, 1971) at 20 ppm using rice plants, soybeans, sweet potatoes, sesame, tomato, eggplant, green peppers, cucumbers, strawberries, and grapes. However, damage symptoms were not observed in any of the cases.

In the experiments using nitrogen dioxide, the plants were exposed for 4 - 8 hours to 4 - 10 ppm, and the manner in which symptoms of damage appeared was observed. 17 types of plant materials were used (rice plants, buckwheat, soybeans, taro, sweet potatoes, sesame, tomato, eggplant, cucumbers, green peppers, turnips, lettuce, spinach, strawberries, grapes, Japanese red pine, and Japanese cedar). Symptoms of damage were observed in three of these (buckwheat, soybeans, and grapes). As for the damage symptoms, in the buckwheat and the soybeans, at the time when exposure was concluded the leaf surfaces looked as if they had been treated with wax, and the zones between the veins gradually grew grayish white (buckwheat) or yellowish white (soybeans). In the grapes, on the day after exposure was concluded black-brown spots appeared. In experiments with a nitrogen dioxide concentration of 20 ppm, symptoms of damage appeared within several hours in almost all of the plants listed above. From the manner in which the damage symptoms appeared in the above experiments with high-concentration exposure, it was assumed that nitrogen monoxide has a remarkably low toxicity in comparison with nitrogen dioxide.

Eleven types of plants (rice plants, buckwheat, soybeans, taro, tomato, eggplant, green pepper, turnip, lettuce, spinach, and grapes) were exposed for periods of 13 - 55 days to nitrogen dioxide concentrations of 0.3 ppm and 0.6 ppm, and the effects were studied. As a result, damage symptoms were seen during the period of exposure in the tomatoes, eggplants, and buckwheat. Leaf fall was pronounced in the eggplants, and the buckwheat had small leaves (0.6 ppm section). A study of the state of growth when exposure was completed revealed that the buckwheat, eggplants, and turnips had inhibited growth (Tables 1-2). On the other hand, some of the plants, such as the rice plants, had increased growth and yield when exposed to the gas (Table 3). When they were exposed for prolonged periods to low concentrations, there was a tendency for the nitrogen in the form of nitric acid in the plant bodies to increase, and absorption of nitrogen dioxide was conceivable. At the same time, there was also an increase in the total nitrogen. However, depending upon the time when the surveys were made, there were also cases when the tendency for the nitrogen in the form of nitric acid and the total nitrogen to increase was not evident.

Table 1

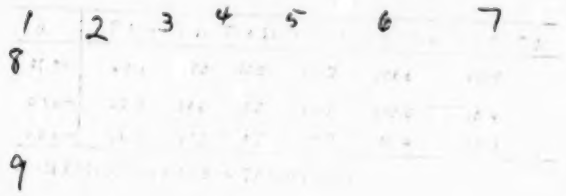
Effects of NO_2 on buckwheat (per plant)



Key:
1. Section
2. Height (cm)
3. Number of leaves
4. Fresh weight (g)
5. Leaves
6. Stalks
7. Dry weight (g)
8. Control
9. Period of exposure, Sept. 22 - Oct. 22, 1970 (30 days)

Table 2

Effects of NO_2 on eggplants (per plant)



[Key on next page]

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Key to Table 2:

1. Section
2. Height (cm)
3. Number of leaves
4. Number of fruits
5. Fresh weight of fruits (g)
6. Fresh weight of leaves and stems (g)
7. Dry weight of leaves and stems (g)
8. Control
9. Period of exposure, June 11 - July 11, 1971 (30 days)

Table 3

Effects of NO_2 on yields of rice plants (per plant)

1	2	3	4
5	13.0	37.5	19.7
0.3 ppm	15.4	37.6	18.1
0.6 ppm	15.8	37.2	24.3

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Key: 1. Section
2. Number of ears
3. Straw weight (g)
4. Unpolished rice weight (g)
5. Control
6. Period of exposure, June 11 - August 2, 1971 (51 days)